

Study of the TCP/IP Layers

Study of the TCP/IP Layers:

Features

Protocols

**Processes,
User Applications**

Application

**HTTP, FTP, SNMP
SMTP, DNS,....**

Ports numbers

Transport

**TCP
UDP**

**Addressing,
Routing**

Internet

**IP
ARP
ICMP**

Signal Conversion,
Error Control

Network Access

**ETHERNET
FDDI
...**

Study of the TCP/IP Layers: Network Access Layer

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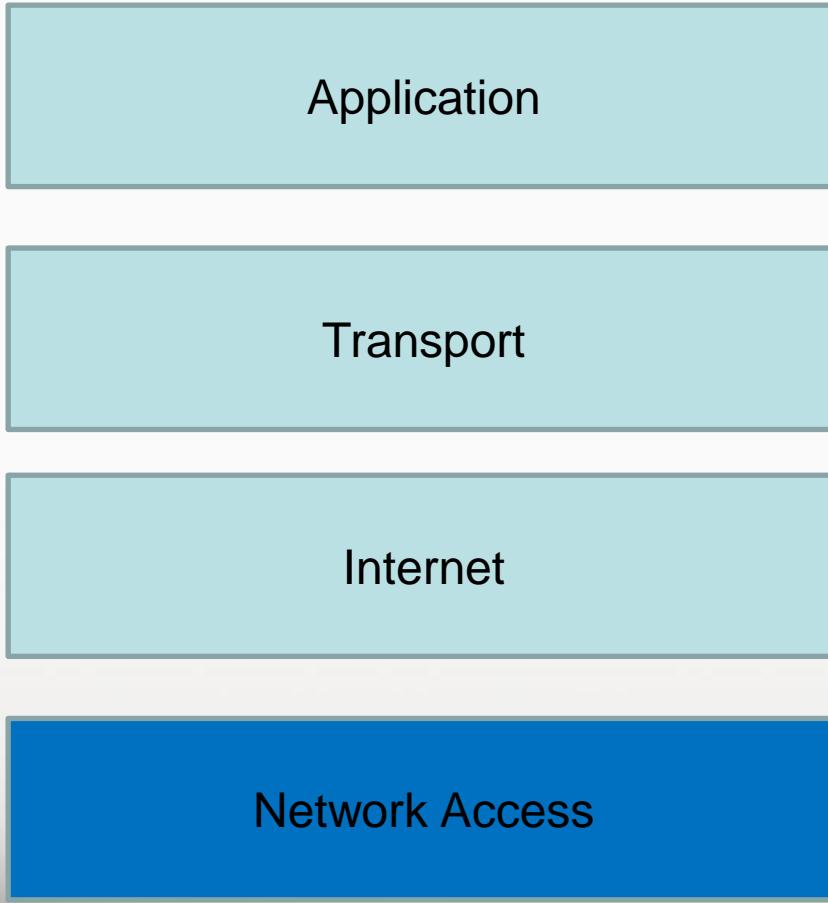
Study of the TCP/IP Layers: Network Access Layer

It includes all the specifications related to data transmission over a physical network:

local area network (Ethernet, FDDI, etc.), telephone lines, etc

- Routing of data over the link.
- Coordination of data transmission (synchronization).
- Data format.
- Conversion of analog/digital signals.
- Error checking upon arrival.

Study of the TCP/IP Layers: Network Access Layer



Study of the TCP/IP Layers: Network Access Layer

2 Sub-layers:

MAC : Medium Access Control (MAC).

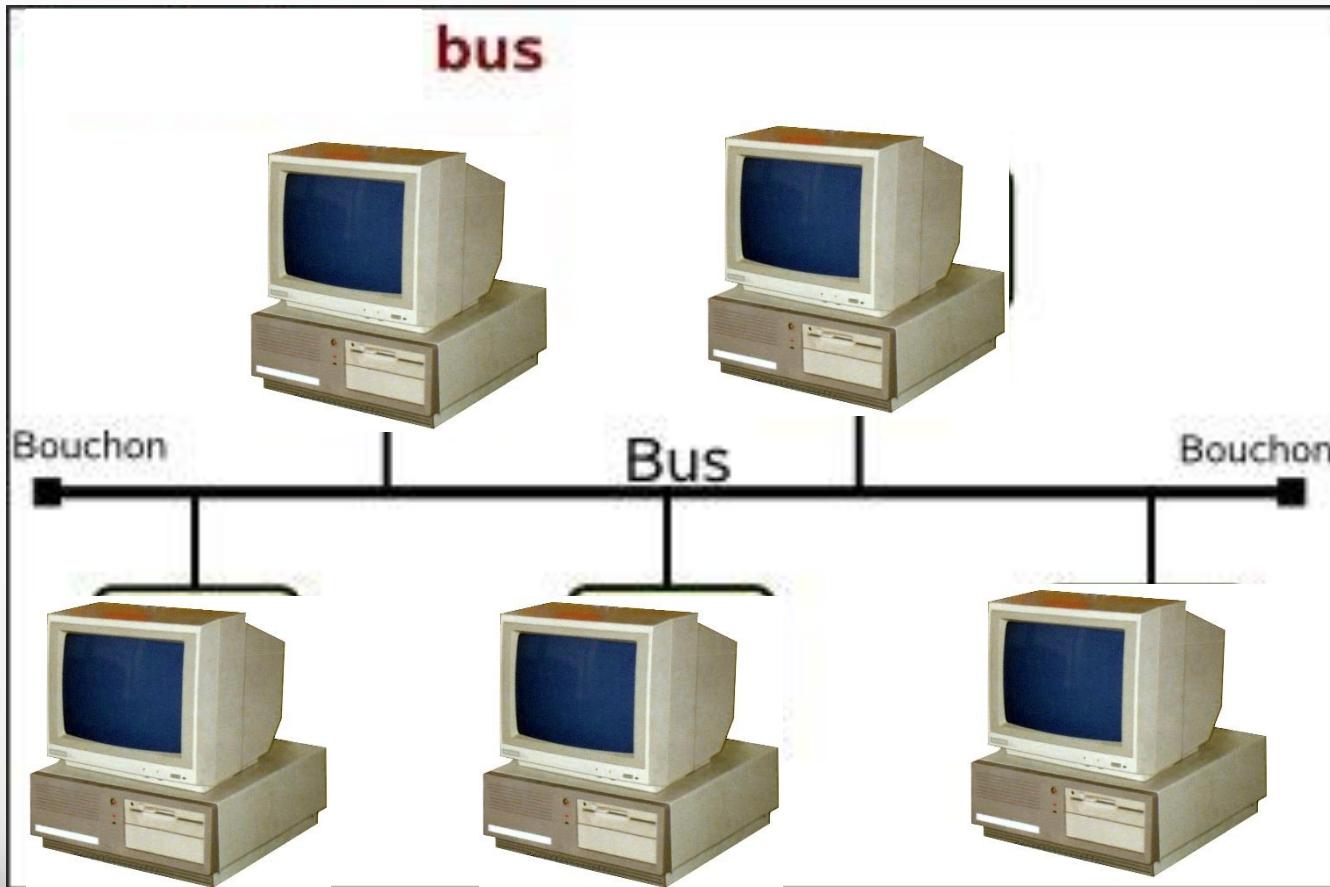
LLC : Error and Flow Control



OSI

Example: Ethernet Network

Classic Ethernet Network



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Network cables



10Base-5: Large-diameter coaxial cable.

10Base-2: Small-diameter coaxial cable.

10Base-T: Twisted pair, the achievable speed is around 10 Mbps.

100Base-TX: Like 10Base-T with a speed of 100 Mbps..

We talk about cable categories: CAT5 → CAT8.

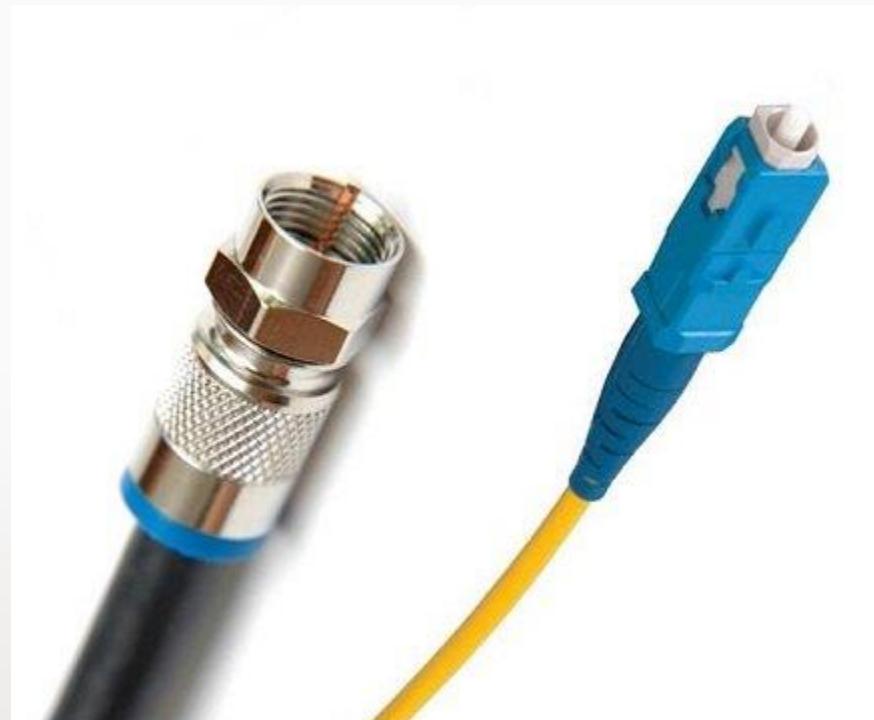
100 Mbit/s->40 Gbit/s



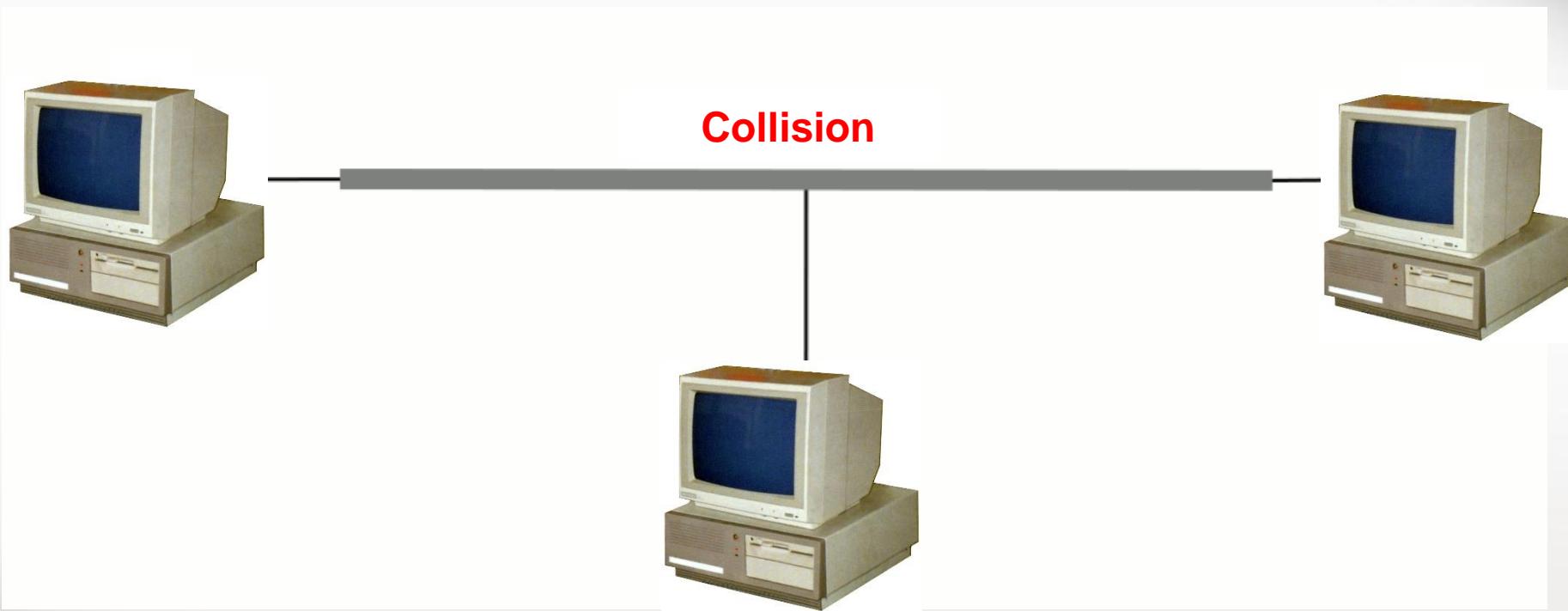
Different types of shielding are also mentioned: U/UTP cable, S/FTP, SF/FTP, etc.

Network cables

Optical fiber

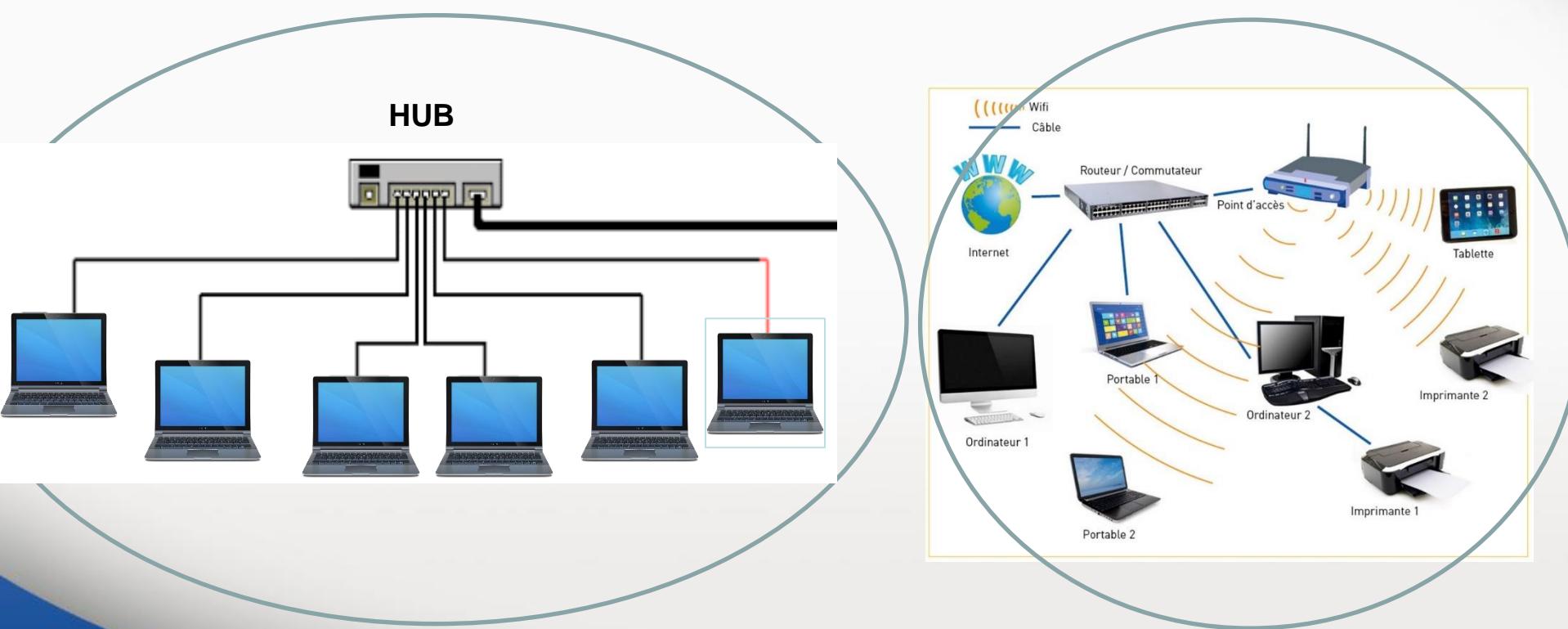


Classic Ethernet network Collision problem



collision domain.

- Wi-Fi and the hub also form one collision domain.



CSMA/CD protocol

- The MAC sublayer uses the CSMA/CD protocol: (Carrier Sense Multiple Access with Collision Detection).
- A multiple access protocol with:
 - Carrier Sense (Monitoring of the carrier), and
 - Collision Detection for frame transmission (bit streams).**

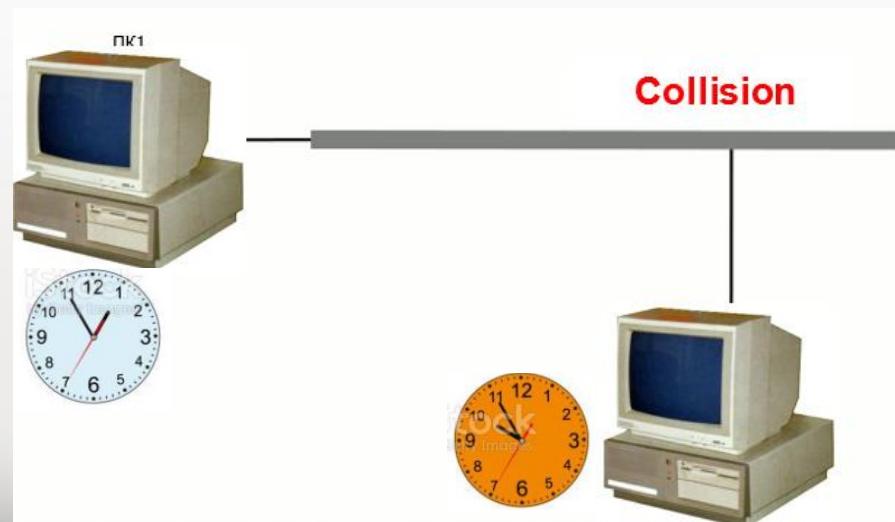


CSMA/CD protocol

Each machine checks that there is no communication on the line before transmitting.

**If two machines transmit simultaneously, a collision occurs:

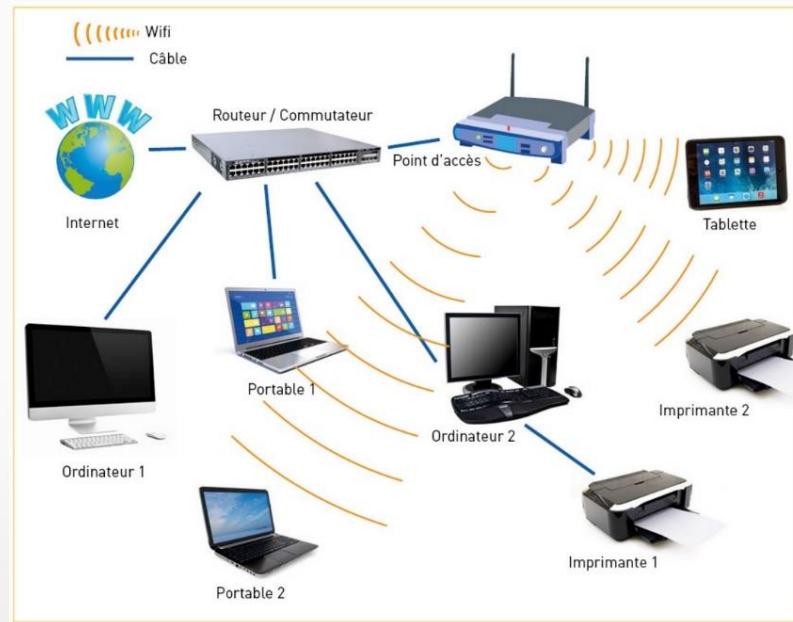
- Both machines stop their communication,
- Wait for a random delay,
- Then, the first one to pass this delay can retransmit.**



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Other protocols

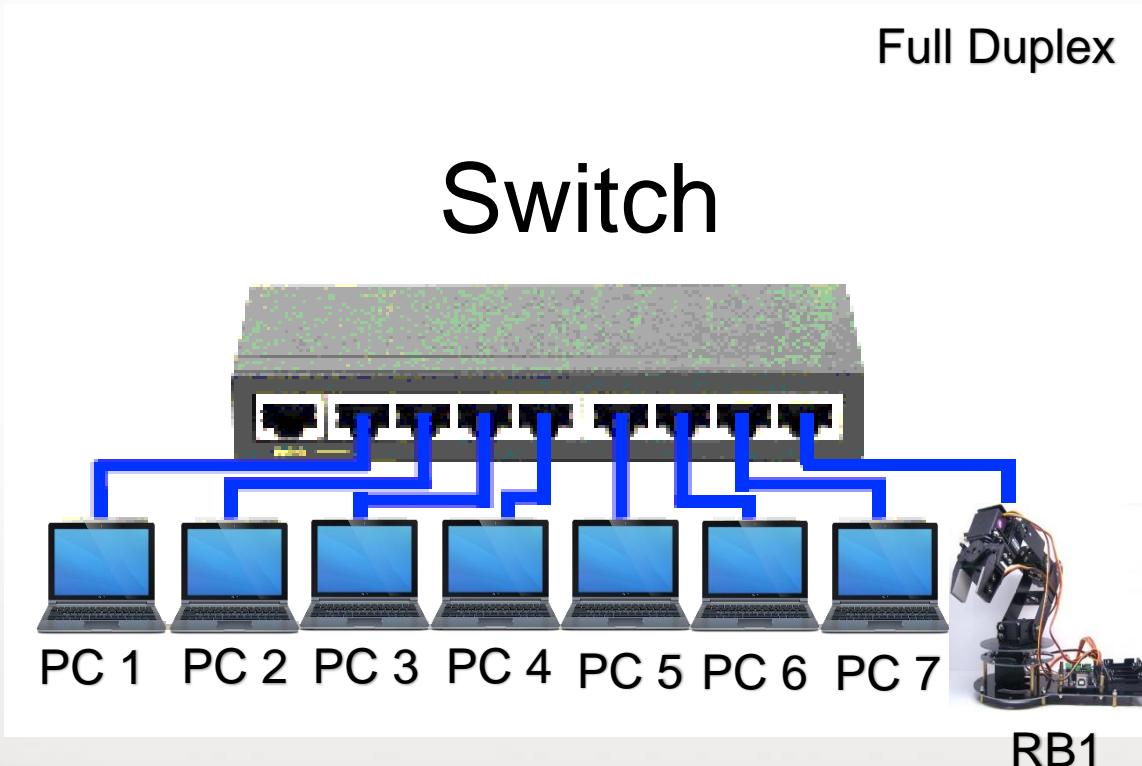
- For Wi-Fi, the CSMA/CA protocol with RTS/CTS is used.



We also talk about:

CSMA/CR used in CAN networks (Controller Area Networks) used in many industries, such as automotive.

Switched Ethernet



Ethernet Commuté

The physical topology remains a star, organized around a switch.

Each exchange can occur at nominal speed (no bandwidth sharing), without collisions, resulting in a significant increase in network bandwidth (at equal nominal speed).

All ports on a switch can communicate simultaneously without message loss.

Example of data encapsulation.

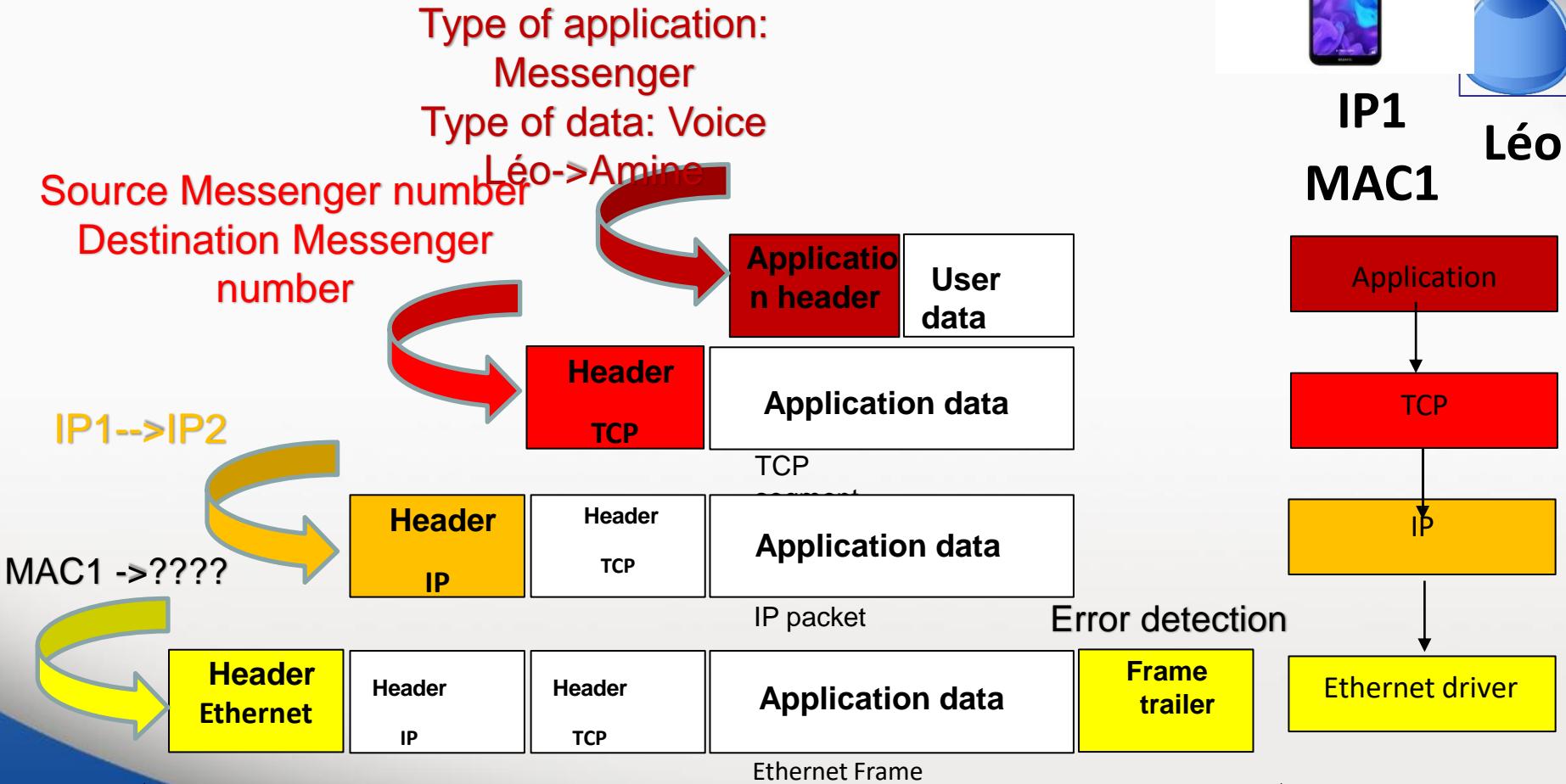


Allo!



IP1

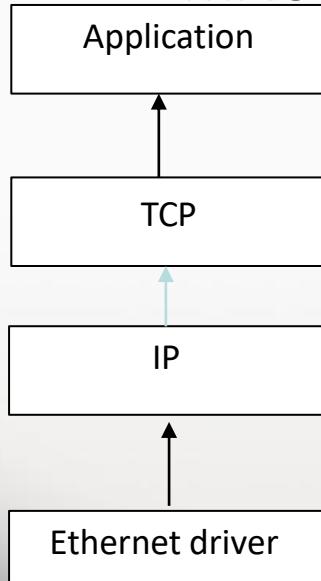
Léo



Example of data encapsulation



Amine IP2
MAC2

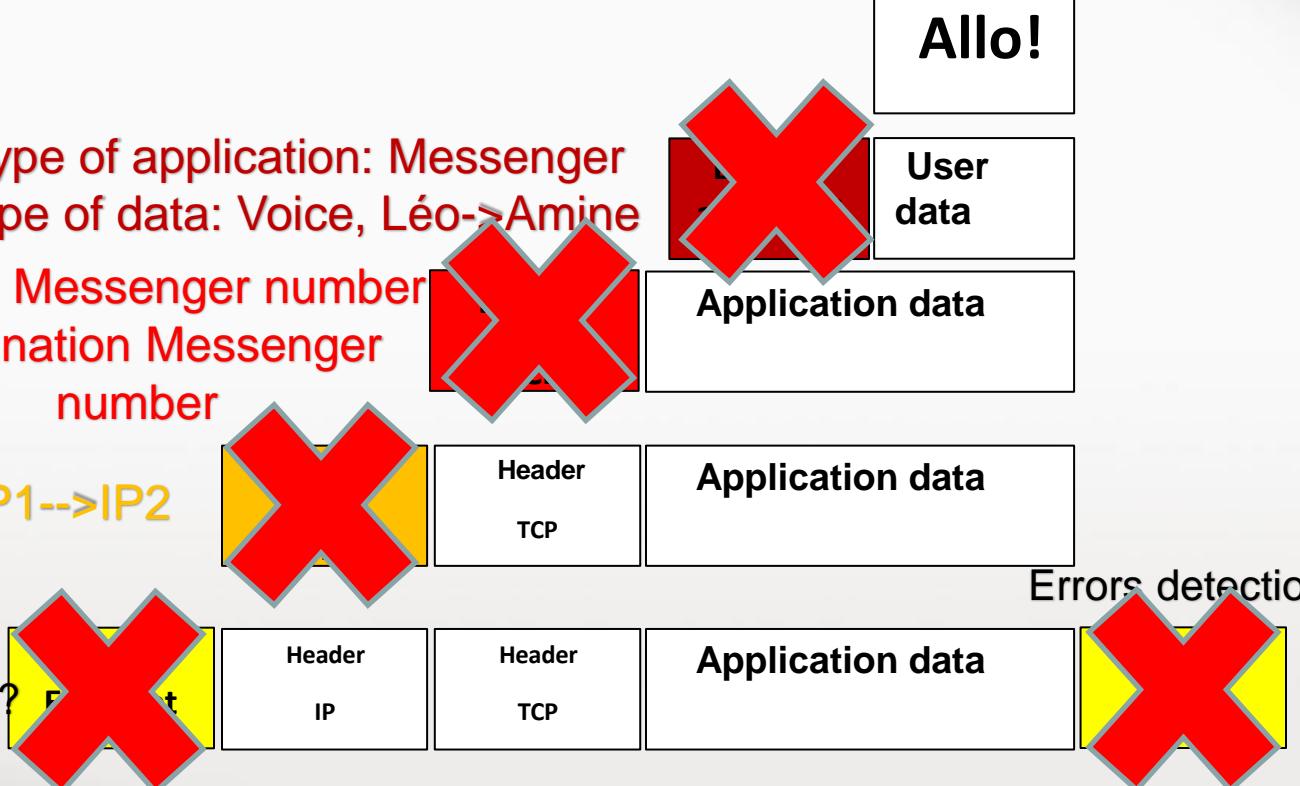


Type of application: Messenger
Type of data: Voice, Léo->Amine

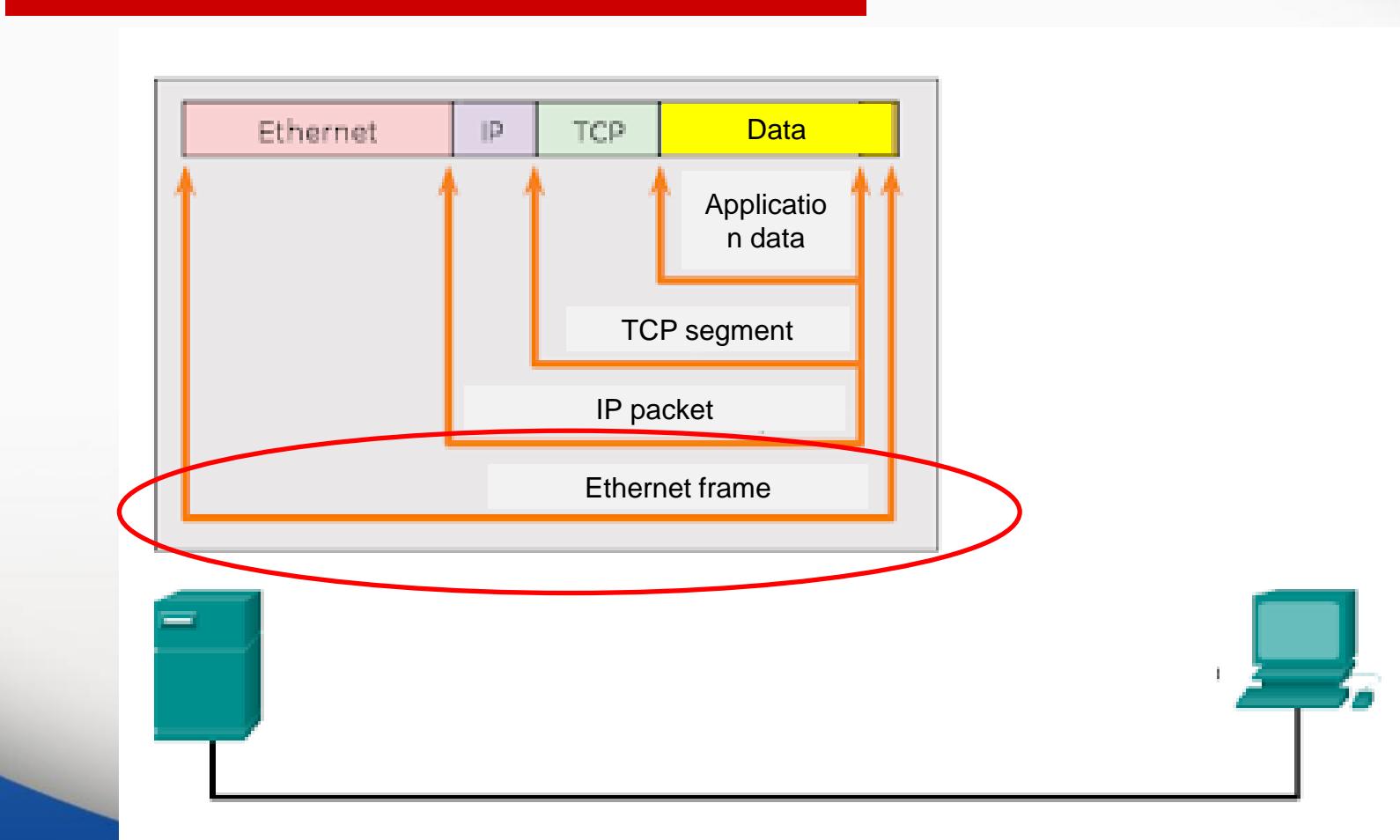
Source Messenger number
Destination Messenger number

IP1-->IP2

MAC2?? Ethernet

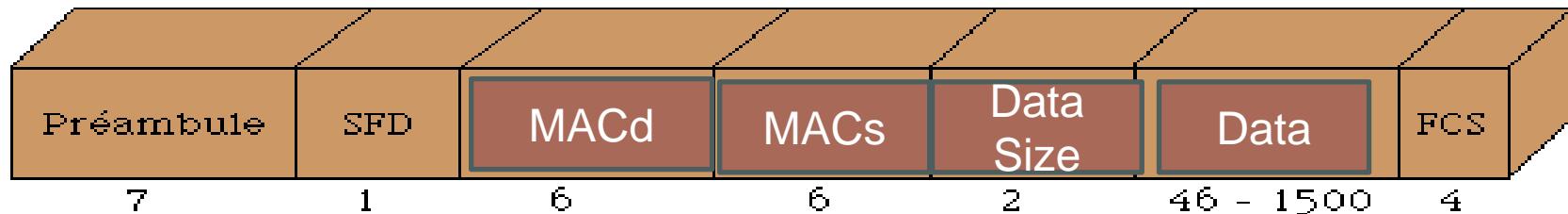


The traveling packet !



Ethernet Frame

Ethernet Frame



SFD : Start Frame Delimiter

FCS : Frame Control Sequence

Préambule, Controls the synchronization between the transmitter and the receiver.,

Start Frame Delimiter (SFD), Indicates the beginning of the frame.

The two pieces of information are a sequence in the format 10101010....

Frame Check Sequence (FCS) To validate the integrity of the frame..

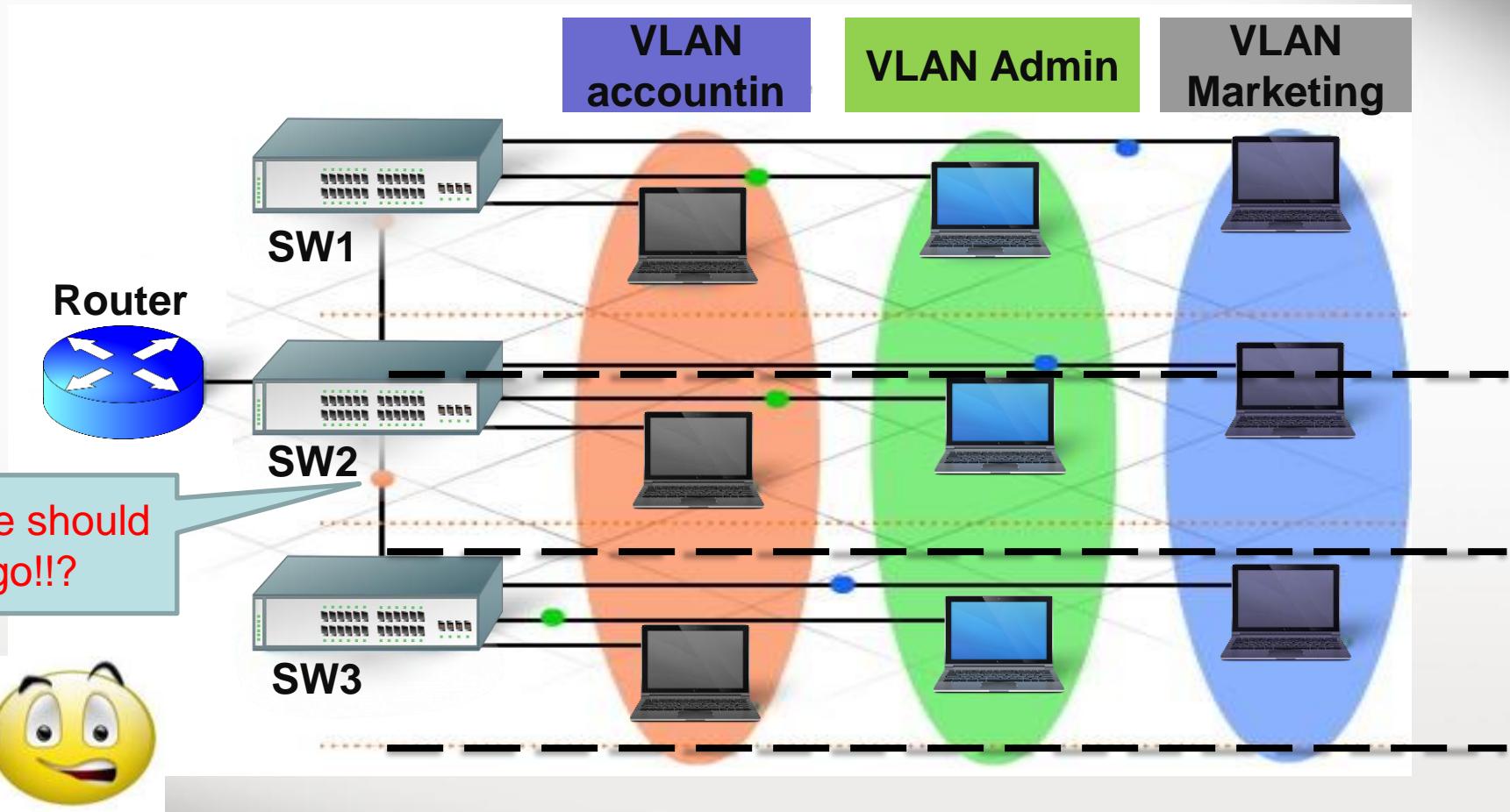
The packet is terminated by an Inter Frame Gap, which is a frame-to-frame delay of 9.6 microseconds.

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VLAN Frames

VLAN Frames



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VLAN Frames

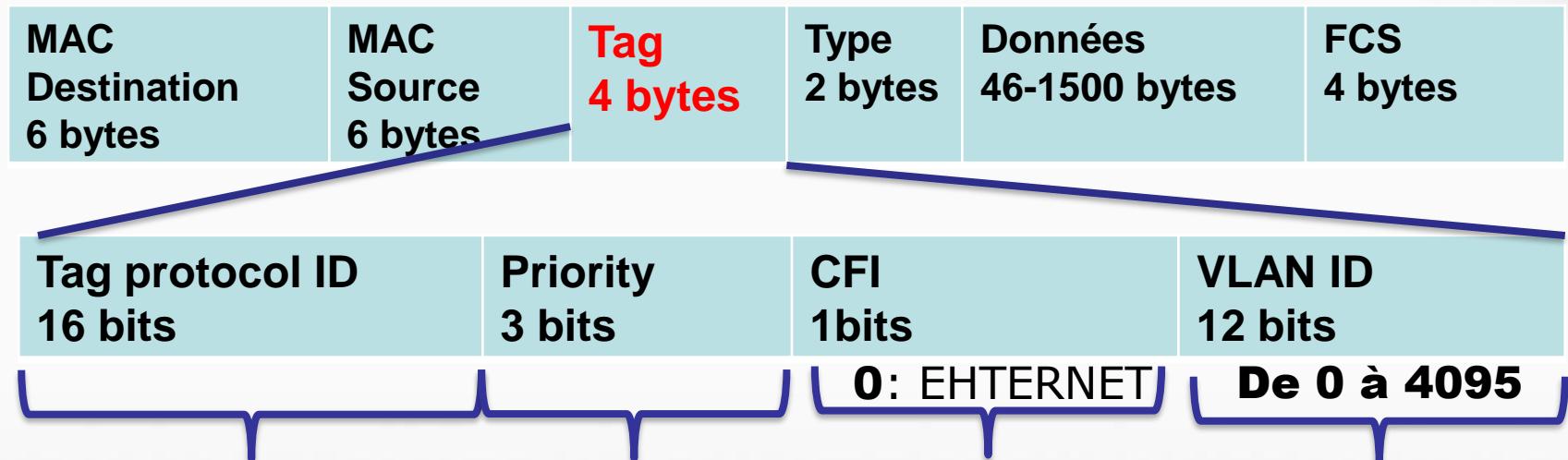
When multiple switches need to be connected to create different VLANs, it is necessary to exchange frames belonging to different VLANs between these switches. It is important to know which VLAN a frame belongs to.

We must "note" which VLAN each frame belongs to.

- We use the IEEE 802.1Q standard:
 - It uses "frame tagging," i.e., frame labeling.
 - The tags allow us to know which broadcast domain the frame belongs to;
 - It is possible to place multiple tags in a frame.
-

Les VLANs and trunking

802.1Q (dot1Q) standard



Replace the type and identify the frame as a VLAN frame (value 0x8100)
9100
9200

802.1P standard
1: low priority
7: highest priority
0: no priority
Priority of VLAN frames relative to other VLANs.

0: The frame does not belong to any VLAN
1: Management VLAN
4095: Reserved
1002 to 1005: Reserved

Les VLANs and trunking

802.1Q (dot1Q) standard

MAC Destination 6 bytes	MAC Source 6 bytes	Type 2 bytes	Données 46-1500 bytes	FCS 4 bytes
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Classic frame without VLAN

MAC Destination 6 bytes	MAC Source 6 bytes	Tag 4 bytes	Type 2 bytes	Données 46-1500 bytes	FCS 4 bytes
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Tagged 802.1Q frame

MAC Destination 6 bytes	MAC Source 6 bytes	Tag 4 bytes	Tag 4 bytes	Type 2 bytes	Données 46-1500 bytes	FCS 4 bytes
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Doubly-tagged frame

Les VLANs and trunking

802.1Q (dot1Q) standard

It adds:

- 4 bytes to the frame format, between the source MAC address and the type field in the frame;
- The maximum frame size increases from 1518 bytes to 1522 bytes.
- A VLAN identifier ranging from 0 to 4095.

It is possible to use double tagging, called "q in q," to allow an ISP to have its own VLANs in addition to those of the client (in cases where the client's sites are dispersed and need to communicate through the ISP).

The 802.1p standard integrates priority concepts to prioritize VLAN traffic and enable QoS (Quality of Service).

Les VLANs and trunking

802.1Q (dot1Q) standard

Tag protocol ID 16 bits	Priority 3 bits	CFI 1 bits	VLAN ID 12 bits
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- **TPID, "Tag Protocol Identifier"**: replaces the type in an 802.3 frame and identifies the frame as a VLAN frame (value 0x8100).
- **PCP, "Priority Code Point"**: a 3-bit field ranging from priority 1 (lowest) to 7 (highest), with value 0 indicating no priority. These priorities can be associated with traffic classes such as voice, video, data, etc.
- **CFI, "Canonical Format Indicator"**: compatibility with Token Ring. A frame with CFI set to 1 (non-canonical MAC) should not be forwarded to an untagged port not associated with a VLAN.
- **VID, "VLAN Identifier"**: identifies the VLAN. Number 1 is associated with an administrative management VLAN, and value 0 indicates that the frame does not belong to any VLAN.

